

REMARKS

Claims have been amended, and support for the amendments is found in the Application. *See, e.g.*, Figures 4-6 and related written description. No new matter has been added.

Applicant submits this Amendment "C" and RCE for the Examiner's consideration. Reconsideration of the application, as amended, in view of the following remarks are respectfully requested.

1. STATUS OF THE CLAIMS

Claims 1-20 were presented for examination and they stand rejected and pending in the application. These claims have been amended and the rejections are addressed below.

2. RESPONSE TO REJECTIONS

2.1. Claim Rejections Under 35 U.S.C. § 103(a)

The pending claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lee, *et al.*, U.S. Pat. No. 5,192,703 (hereinafter "Lee") in view of Havemann, U.S. Pat. No. 5,482,894 (hereinafter "Havemann"). Claims 4, 9, 10, 14, 19 and 20 are rejected in view of Lee and Havemann and further in view of Ahmad, *et al.*, U.S. Pat. No. 5,208,176 (hereinafter "Ahmad").

Lee does not disclose or suggest the presently claimed devices. For example, Lee does not disclose or suggest:

(a) an undoped silicon dioxide cap on and in contact with the layer of refractory metal silicide. In fact, Lee teaches on the combination of an additional etch stop, thick nitride layer 20 on top of an oxide layer 16. *See, e.g.*, Lee, col. 5, *ll.* 39-45, Fig. 22.

(b) A spacer that is over and in contact with the semiconductor material layer as recited in the pending claims. The combination of spacer and a gate layer disclosed in Lee are such that the spacer is over and in contact with the gate layer (*see, e.g.*, Lee, Fig. 22).

(c) A contact plug that is situated, *inter alia*, over a portion of the undoped silicon dioxide cap.

(d) A layer of doped silicon dioxide over and in contact with the spacer, over and in contact with the undoped silicon dioxide cap, and adjacent to and in contact with the contact plug.

(e) A refractory metal layer that has on one of its sides the spacer and the doped silicon dioxide layer that satisfies the recited limitations.

Furthermore, Lee does not disclose a spacer that comprises undoped silicon dioxide and that is integral with the undoped silicon dioxide cap (*see, e.g.*, claim 9) and a spacer that is made from the same material as the undoped silicon dioxide cap (*see, e.g.*, claim 19).

Neither Havemann nor Ahmad, even if they were combinable references amongst themselves and/or with Lee, are cited as providing any basis that would overcome the limitations and differences established with respect to the disclosure in Lee and the presently recited features. Therefore, even if the cited references were combinable, they do not teach or suggest the claim limitations, and they do not provide any suggestion or motivation to combine and/or modify reference teachings to arrive at the present claims, viewed as a whole, with a reasonable expectation of success.

In addition, Havemann discloses the use of electrically insulating caps on top of electrically conducting features where the insulating cap materials may comprise silicon dioxide, silicon nitride, or silicon oxynitride. This disclosure is provided in the context of removal of organic-containing materials in the manufacturing of self-aligned contacts on semiconductor devices. *See, e.g.*, Havemann, col. 2, *ll.* 10-11, 42-45, 66-67, col. 3, *ll.* 1, Figs. 1A-1B and legends related thereto. It

does not follow from the teachings in Havemann that such reference provides any suggestion or motivation to alter reference teachings for the purpose of manufacturing and forming devices such as those presently recited, with the presently recited features, and with a reasonable expectation of success in addressing and solving the problems as set forth in the present Application.

“To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation ... to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.” Furthermore, the “teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant’s disclosure.” (citations omitted) M.P.E.P. §§ 2142, 2143, p. 2100-121, -122, 8th ed. (Aug. 2001). For at least the reasons set forth above, Applicant respectfully submits that these criteria are not satisfied by Lee, Havemann, and/or Ahmad.

Because of differences and limitations such as those described hereinabove, the cited references have not suggested the claimed subject matter, and it may not be asserted that the teachings provided by such references are sufficient for one of ordinary skill in the art to make the substitutions, combinations or other modifications that are necessary to arrive to the presently claimed devices.

Consequently, Applicant respectfully submits that the cited references do not support a *prima facie* case of obviousness regarding the pending claims. Applicant respectfully requests the reconsideration and withdrawal of this rejection.

The Office Action cites *In re Leshin*, 47 C.C.P.A. 909, 277 F.2d 197, 125 U.S.P.Q. 416, in the context of the combination of the disclosure in Lee with the disclosure of an insulating cap

material in Havemann. Applicant respectfully traverses the use of *In re Leshin* in the present context.

In this regard, Applicant notes that *In re Leshin* sets forth that "the selection of the plastics being on the basis of suitability for the intended use, would entirely be obvious" in a context in which the selection refers to "known plastics to make a container-dispenser of a type made of plastics prior to the invention." *In re Leshin*, 125 U.S.P.Q. at 417-18. These quotes from *In re Leshin* reveal that obviousness *In re Leshin* was predicated on the basis of at least the following conditions: A material that (a) was known, (b) the structures made with such material were known, and (c) the use of such material for such purpose was also known. As reasoned herein, these conditions are not satisfied as to the art of record in reference to the presently claimed devices. Furthermore, and in contrast with the conditions for the ruling in *In re Leshin*, the presently claimed devices are formed in the context of unsolved problems as indicated in the Application. *See, e.g.*, Application, p. 3, *ll.* 25-26, p. 4, p. 6, *ll.* 3-10. Because the conditions for the ruling in *In re Leshin* are not satisfied in the present context, Applicant respectfully submits that *In re Leshin* is not applicable authority in the present context.

3. **CONCLUSIONS**

In view of the above, Applicant respectfully maintains that the present application is in condition for allowance. Reconsideration of the rejections is requested. Allowance of the pending claims at an early date is solicited.

In the event that the Examiner finds any remaining impediment to a prompt allowance of this application which could be clarified by a telephonic interview, or which is susceptible to being overcome by means of an Examiner's Amendment, the Examiner is respectfully requested to initiate the same with the undersigned attorney.

Dated this 24th day of June 2002.

Respectfully submitted,



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PATENT TRADEMARK OFFICE

Marked up Version of the Pending Claims Under 37 C.F.R. § 1.121(c)(1)(ii):

Applicant submits the following marked up version only for claims being changed by the current amendment, wherein the markings are shown by brackets (for deleted matter) and/or underlining (for added matter):

1. (Twice Amended) A gate stack structure situated over a semiconductor material layer, said gate stack structure comprising:
 - a gate oxide layer on said semiconductor material layer;
 - a gate layer, comprising a first conductive material, on said gate oxide layer;
 - a layer of refractory metal silicide on said gate layer;
 - an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide;
 - a spacer over a lateral side of the gate layer and in contact with said semiconductor material layer, said spacer comprising a nonconductive material, wherein the lateral side of the gate layer is oriented perpendicular to said base semiconductor material layer;
 - a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated adjacent to the gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and
 - a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said

contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said refractory metal layer comprises one of the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

9. (Twice Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

a gate oxide layer on said monocrystalline silicon layer;

a polysilicon gate layer on said gate oxide layer;

a layer of tungsten silicide on said polysilicon gate layer;

an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising undoped silicon dioxide and being integral with the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said base monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said refractory metal layer comprises one of

the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

10. (Thrice Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

a gate oxide layer on said monocrystalline silicon layer;

a polysilicon gate layer on said gate oxide layer;

a layer of tungsten silicide on said polysilicon gate layer;

an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising a material that is one of silicon nitride and undoped silicon dioxide and being made from the same material as the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon

dioxide on the other of said sides, such that said refractory metal layer comprises one of the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

11. (Twice Amended) A gate structure comprising:
a pair of gate stacks situated over a semiconductor material layer, each said gate stack comprising:

- a gate oxide layer on said semiconductor material layer;
- a gate layer, comprising a first conductive material, on said gate oxide layer;
- a layer of refractory metal silicide on said gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide; and
- a spacer in contact with a lateral side of each said gate stack and with said semiconductor material layer, said spacer comprising a nonconductive material, each said lateral side of each said gate stack being perpendicular to said base semiconductor material layer;

a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two

opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said refractory metal layer comprises one of the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

19. (Thrice Amended) A gate structure comprising:
a pair of gate stacks situated over a monocrystalline silicon layer, each said gate stack comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide; and

a spacer over a lateral side of each said gate stack and in contact with said monocrystalline silicon layer, said spacer comprising undoped silicon dioxide and being made from the same material as the undoped silicon dioxide cap, wherein the lateral side of each said gate stack is oriented perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two

opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said refractory metal layer comprises one of the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

20. (Twice Amended) A gate structure comprising:
a pair of gate stacks situated over a monocrystalline silicon layer, each said gate stack comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide; and

a spacer over a lateral side of each said gate stack and in contact with said monocrystalline silicon layer, said spacer comprising a material that is one of silicon nitride and undoped silicon dioxide, each said lateral side of each said gate stack being perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a refractory metal layer is disposed along said lateral wall of said contact plug, said refractory metal layer having said contact plug on one of its two

opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said refractory metal layer comprises one of the materials selected from the group consisting of a refractory metal, a refractory metal silicide, and combinations thereof.

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